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ABSTRACT

Very little cognitive development research has been done among African children, and most of the completed studies have relied on "translated" versions of Western test materials that are inappropriate to the African milieu. This paucity of research has had two affects: (1) rural African children have been represented as somewhat less advanced mentally than Western children; and (2) it has kept researchers from discerning whether the patterns of development discovered among Western children are truly universal or merely a product of Western cultural and educational systems. Described are methods developed to study how Kamba children in Kangundo, Machakos (Kenya), acquired adult semantic categories and to investigate the child's learning of certain aspects of logical thinking. Animals were chosen as a semantic domain familiar to Kamba children. The domain's structure was described, using Kikamba-speaking adults as informants who were asked to match "those which are alike" and to give their reasons for the groups they formed. Next, four sorting tests were administered to 30 Akamba children, ages 6, 7, 9, and 12. Some tentative findings were that not surprisingly, children learn more adult dimensions as they get older, and the younger child's sorting ability far exceeded his ability to verbalize the reasons, particularly with very familiar animals. (NQ)

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METHODS OF INVESTIGATING COGNITIVE DEVELOPMENT OF CHILDREN IN RURAL KENYA: SOME KAMBA RESULTS

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Theories of cognitive development have been based almost exclusively on studies conducted among American and European children. Very little research of this kind has been done among African children. Furthermore, most of the studies completed to date have relied primarily on "translated" versions of standard tests. This generally has involved the use of Western materials inappropriate to the African milieu. The paucity of research and the dearth of well-designed studies among African children has had two undesirable consequences. First, it has represented rural African children as being somewhat less advanced mentally than Western children. Secondly, it has kept us from discerning whether the patterns of development discovered among Western children are truly universal or are simply products of Western cultural and educational systems.

The subject of this paper is a description of the methods I have developed for my current study among Kamba children in Kangundo, Machakos. This methodology attempts to overcome some of the shortcomings I have pointed out. The goals of my research are: to describe how children acquire adult semantic categories, and to investigate the child's learning of certain aspects of logical thinking.

The method I used first required the selection of a semantic domain. A semantic domain is the set of terms that people use to label such things as "plants," "animals," "colours," "kinship terms," "disease," and so forth. The domain, however, must be one which the people themselves consider to be a reasonable category. I chose the domain of animals as it was one with which Kamba children had a fair degree of familiarity. The next step was to describe the structure of the domain using Kikamba-speaking adults as informants. To describe the structure, one must know: what the major categories (of animals) are, and how the categories are related to one another. I also was interested in the dimensions, (e.g. big vs. small; walks vs. flies) which were used in categorising animals. In doing a study like this, the investigator must be careful not to impose any of his own ideas. He should, rather, elicit those of the indigenous people. Although there are many methods for discovering these categories, I found the best one to be "free sorting." After eliciting a list of animal names, I made out a set of cards with the Kikamba animal names written on them (with illiterate adults, I used pictures) and asked my informants to put "those which are alike" together. I then asked them to give me their reasons for the groups they formed. The structure of the domain of animals is partially summarised in the taxonomy on the following page. (Note: The taxonomy shown on page 2 is only partial. It excludes snakes, reptiles, and certain odd-ball animals. Further, only the major subdivisions are presented).

Certain problems arose, however, with using this particular structural device (a taxonomy). It definitely does not represent what all Akamba would do, given a sorting test. In practice, there is a high agreement between informants on: what animals go together, and what criteria one uses in sorting. There is considerable divergence, however, as to the order in which the criteria should be applied. An example of this arises within

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PARTIAL TAXONOMY OF KIKAMBA ANIMAL TERMINOLOGY

SYUMBE (creatures)

NYAMU (animals) 4 legged								NYUNYI (birds)	
NYAMU SYA KITHEKANI (wild animals)					NYAMU SYA MUSYI (domestic animals)		NYAMU SYA KIWU'INI (water and)	NUNYI SYI KITHEKANI (wild birds)	
SYIMAVUNGU (hoofed)		SYA ITHU (with paws)			IISAWA (edible)	ITAISWA (inedible)	nguu hippo	IISAWA (edible)	ITAISAWA (inedible)
MBAI (fierce)	ITE MBAI (not fierce)	MBAI (fierce)		ITE MBAI (not fierce)	ngombe cow	mbaka cat	ikuyu fish	ivui dove	kilui kite
			IISAWA NYAMA	MAIMANI	OTHERS*	ilondu sheep	ngiti dog	mukunga whale	mithonsye weaver-bird	ndiu eagle
mboo buffalo	nthwaia gazelle	nzou elephant	munyambu lion	luma anteater	nzui fox	mbui goat	ngiti	kingangi crocodile	nævele sunbird	mbolosya hawk
mbusya rhino	kilong'a antelope		ngo leopard	mbuko mole	mbiti hyena			kyoa frog	kteetee wren	ndei vulture
	mbii Dik-Dik		ndw'a mutwe tiger	mbia rat	nguli monkey			nguu tortoise	ngangi'a guinea fowl	ngunguu crow
	nthia steenbuk n			nduu squirrel	nzee porcupine			ndundyo toad		ndundula owl
	nguuwe wild pig				mbuku hare					
	ngatata									
	nzai zebra									
	ndwia giraffe									

PARTIAL TAXONOMY OF KIKAMBA ANIMAL TERMINOLOGY

SYUMBE (creatures)

NYAMU (animals) 4 legged

THEKANI (s)

ITHU (th paws)

ITE MBAI (not fierce)

MAIMANI	OTHERS*
luma anteater	nzui fox
mbuko mole	mbiti hyena
mbia rat	nguli monkey
nduu squirrel	nzee porcupine
	mbuku hare

NYAMU SYA MUSYI (domestic animals)

IISAWA (edible)	ITAISWA (inedible)
ngombe cow	mbaka cat
ilondu sheep	ngiti dog
mbui goat	ngiti

NYAMU SYA KIWU'INI (water ani.)

nguu hippo
ikuyu fish
mukunga whale
kingangi crocodile
kyoa frog
nguu tortoise
ndundyo toad

NYUNYI (birds)

NUNYI SYI KITHEKANI (wild birds)

IISAWA (edible)	ITAISAWA (inedible)
ivui dove	kilui kite
mithonzwe weaver-bird	ndiu eagle
nzevele sunbird	mbolonya hawk
kiteetee wren	ndei vulture
ngangia guinea fowl	ngunguu crow
	ndundula owl

NYUNYI SYA MUSYI (domestic birds)

nguku chicken
ivata duck
mavui pigeon
mbata musinaa turkey

TUSAMUI (insects)

TLUKUKAA (flying)

umuu mosquito
mbaa whitefly
ngi fly
ngi locust
kimbalutya butterfly
kitooli grasshopper
nzuki bees

TUTAULUKAA (not flying)

ngunguni bedbug
ndaa lice
ngala flea
mbili tic
nyenze cockroach
muthwa whiteant
nthingii blackant
nguku red ant

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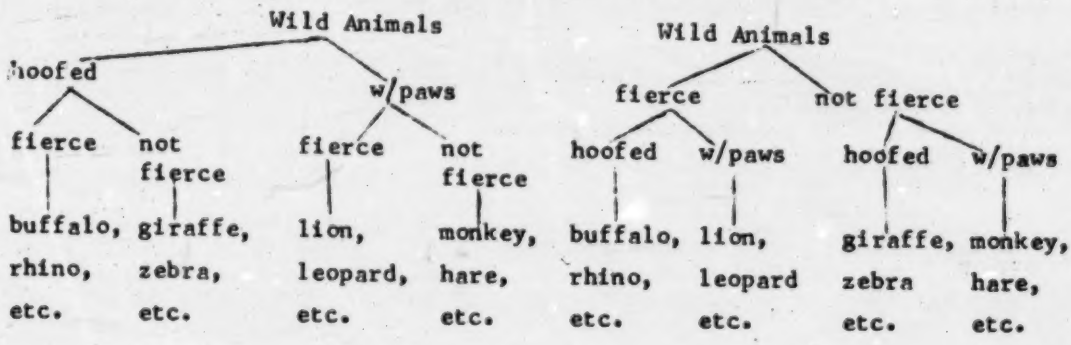
the category nyamu sya kithekani (wild animals). Referring to the taxonomy on page 2, one can see that the two major ways of subdividing wild animals are: hoofed vs. has paws, and fierce vs. not fierce. In the taxonomy given here, hoofs vs. paws is shown as the initial subdivision, but some Akamba would proceed in the reverse order (sorting by "fierceness" first, and then by whether they had hoofs or paws). Thus, the two acceptable ways of categorising wild animals are:

FIGURE 2: TREE DIAGRAM OF WILD ANIMALS



Regardless of which alternative is followed, however, the resultant groupings are identical. Thus, a taxonomy is not the best way of describing the system. A tree diagram with optional choices would be a more accurate representation. From this, then, I concluded that, in the domain of Kikamba animal terminology, there is cultural sharing with regard to which animals are more alike and what dimensions are relevant in classification. How one applies these dimensions, however, is a matter of individual preference. It is not a part of shared cultural knowledge. Therefore, in testing children, any of the acceptable adult criteria applied in any order would qualify as "acquisition" of that part of the adult system.

After completing my analysis of the adult responses, I developed a series of sorting tests to be administered to a sample of Akamba children. The purpose of the tests was to discover in what manner children acquire the semantic categories of the chosen domain. In addition, this procedure would allow me to examine the formal characteristics of the children's sorting, given familiar materials.

I gave four sorting tests to a total of thirty children, divided into three groups. The first group consisted of ten six and seven year-olds who had not yet entered school, the second consisted of ten nine year-olds in Standard I, and the third consisted of ten twelve year-olds in Standard III. At the time of the testing, the nine year-olds had had only six months of schooling and were, for all intents and purposes, "illiterate." Further, none of the children had been exposed in school to scientific instruction in the classification of animals.

The first test I used consisted of asking the children to sort pictures of 17 animals which were more or less familiar to them. (Specifically, the animals pictured were: cow, goat, cat, dog, chicken, duck, owl, monkey, hare, elephant, giraffe, leopard, frog, tortoise, fly, butterfly). The second test was designed to

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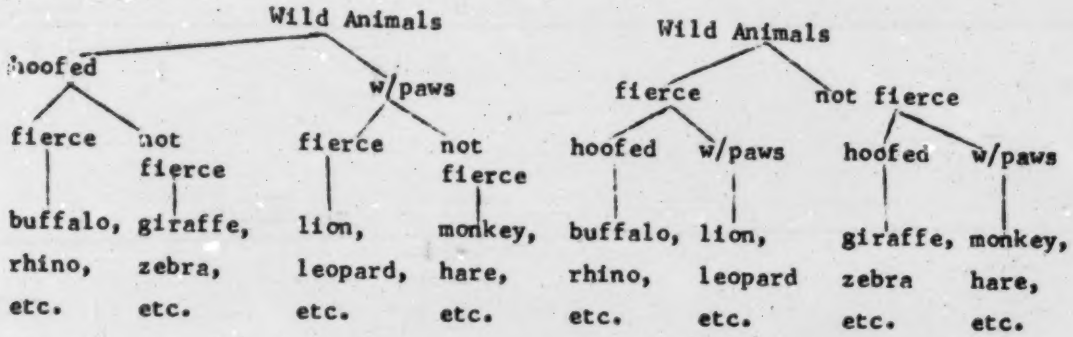

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see if the children had mastered the domestic-wild-water distinction among animals. It involved pictures of six animals: cow, dog (for domestic); zebra, elephant (wild); and fish, frog (water). The third test was aimed at discovering the child's acquisition of the categories animals, birds, insects. Birds were represented by a duck and an owl; animals by a rat and a monkey; insects by a fly and a caterpillar. (I found, however, that even the older children saw no similarity between a fly and a caterpillar, and that only the most sophisticated adults could verbalise a shared common attribute. Therefore, I discounted these two items and will not report the rather meaningless results). The final test used was a set of six wild animals (leopard, tiger, giraffe, zebra, buffalo, elephant) and was administered only to the nine and twelve year-olds, as the six and seven year-olds were insufficiently familiar with these animals.

THE ACQUISITION OF ANIMAL TERMINOLOGY

The first statement that can be made about the results of these tests is not a surprising one: children learn more adult dimensions as they get older. (Table I) A more interesting result, however, is that younger children can sort better than they can give reasons, particularly with very familiar animals. This is apparent on all three tests. Looking at the "easiest" items (for a rural Mukamba) on the 17-animal free sorting test - goat cow, chicken, duck, a majority of the younger children paired them correctly (by adult standards). However, only a minority of them were able to give the acceptable Kamba reasons for doing so. (Table II)

The same thing happened in the wild-domestic-water and bird-animal tests. The younger child's sorting ability far exceeded his ability to verbalise the proper dimensions for correct sorts. (Tables III and IV) The one exception is that all the seven year-olds who put the fish and frog together gave the adult reasons for doing so. I shall comment on this particular outcome later.

It should be noted, on Table III, that no other acceptable Kikamba reason was available for the three pairs listed. However, sorting by other dimensions (and thus forming other pairs such as cow-zebra) was indeed possible. Since some of the twelve year-olds did this, they have relatively low percentages in some of the other rows.

The wild animal test showed a similar gap between nine year-olds and twelve year-olds in terms of the disparity between correct sorting and giving adequate reasons. The nine year-olds did even better than the twelve year-olds in proper grouping on two out of three pairs. (Table V)

However, when it comes to naming adult dimensions, the twelve year-olds perform better. (Table VI) There are two possible explanations for this phenomenon. One would be that young children do not know the proper semantic dimensions, but have had sufficient experience with familiar animals to know which ones are (culturally) more alike. The other explanation would be that children, in fact, know the dimensions at a young age but are unable to verbalise them. The argument which could be made for this latter explanation is that children have the concepts, but they are what the Russian psychologist Vigotsky called "non-conscious spontaneous" concepts. As Vigotsky himself explains it, a child will "form and use a concept quite correctly in a concrete situation but will find it strangely difficult to express that concept in words." (Vigotsky,

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Thought and Language, page 79)

Whether or not the child "knows" certain dimensions at age seven, he does learn to verbalise them by age nine or twelve. The interesting thing here, though, is that his ability to verbalise dimensions seems to proceed from the least familiar animals to the more familiar, the opposite direction of his sorting ability. In the 17-animal free-sorting test, the seven and nine year-olds' most common correct pairs involved domestic animals. Yet, if we look at the reasons, only one child mentioned the fact that these animals were domestic, whereas three children mentioned the complementary dimension of "wild animals." The difference is even more clearly demonstrated in the second sorting test.(Table III) One hundred per cent of the seven year-olds who put fish and frog together gave "water animals" as a reason, 40 per cent of the seven year-olds who put elephant and zebra together mentioned "forest animals." On the other hand, none of the children who put dog and cow together mentioned domestic as a reason, although 60 per cent of the children did group them together. We should note that there could be no other good reason in Kikamba for putting dog and cow together. They share none of the sub-divisions of domestic animals: edibility, "hoofness," whether milked or not, eats meat vs. eats grass, or guard animals.

This, I feel, demonstrates the way in which "pre-conscious spontaneous concepts" become conscious and thus verbally explicit. Thus, the animals a child first becomes familiar with - the goat, cow, dog, etc. - are not labeled "domestic" in his mind, because he has nothing to contrast them with. Later, when he learns there are also elephants, giraffes, monkeys and that these are called "animals of the forest," he can systematise his knowledge by supplying the complementary label "domestic.' Thus, as shown in Tables II and III, the discrepancy between sorting and giving dimensions for domestic animals gradually decreases until, at age twelve, it disappears. To state the proposition another way, the category "domestic animals" takes on an "unmarked" quality - i.e., it is the norm or baseline and only differences are remarked upon. Later, when the "marked" category - i.e., different-from-domestic (wild, water) is mastered, the child can give the unmarked category a label. This, I think, is one of the ways that "natural" learning takes place.

The same phenomenon occurs with flying and non-flying animals. In this case, "birds" or "flying creatures" is the marked category and and four-legged, walking animals is the unmarked category. The marked quality, flying, is mentioned by even the youngest children, whereas it is not until age twelve that children can verbalise the unmarked "walks" or "four-legged" characteristic of nyamu (animals). The results from the free sorting tests are revealing. (Table VII) This may explain why, in the bird-animal test (Table IV), the rat and the monkey were so seldom grouped together by the younger children (10 per cent of the seven year-olds, 20 per cent of the nine year-olds did so vs. 60 per cent of the twelve year olds). However, it should be noted that only 50 per cent of the twelve year-olds gave the correct reason (four-legged or walks) vs. 100 per cent correct reasons for the bird pairs (flies, has wings). It seems that the unmarked quality of the nyamu is insufficiently formulated for a young child to see any similarities between two such disparate animals as a rat and a monkey.

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FORMAL CHARACTERISTICS OF CHILDREN'S SORTING

Almost all psychologists who have investigated cognitive development among rural African children have concluded that they are unable to think abstractly -- that is, they are tied to concrete, perceptible attributes. Jerome Bruner has stated that children in "primitive" rural villages are unable to apply the hierarchical properties inherent in the grammatical structure of their language to the semantic sphere.(Bruner, et al. Studies in Cognitive Growth, 46) In the same book, Patricia Greenfield concluded from her study of the Wolof in Senegal that "Bush children who do not go to school rely on colour attributes at every stage of development." (Greenfield, Ibid., page 315) Witringer, a French psychologist, goes even further saying: "The intellectual inferiority of the African is explained by a mental attitude profoundly conditioned by a concrete, intuitive attitude centered on the syncretic perception of reality." (My translation, Witringer, "Considerations sur l'intelligence du noir africain")

It should be clear from my previous discussion that this is a gross distortion of the situation. The Akamba children I tested were gradually learning to systemise their knowledge about animals. To do so, they were learning both perceptible and non-perceptible attributes as well as a system of hierarchical categories. In giving reasons for their sorting, the children were abstracting attributes common to two or three examplars.

The reason for the difference between my findings and those of Patricia Greenfield is due, I think, to the nature of the materials used for testing. The Wolof children in her sample sorted exclusively by colour probably because many of the objects (clock, bicycle, car helmet) were unfamiliar objects in their rural setting. When I used animals familiar to Akamba children, I had quite different results. Only two out of ten pre-school children sorted exclusively by colour. (A third child sorted by colour originally, but when asked if he could sort another way was unable to do so). Of the nine year-olds (only six months of schooling) only one out of ten children sorted by colour. Nor were these children tied to "perceptible" attributes. As Table VI.. shows, more children sorted by non-perceptible attributes than by perceptible ones.

Another measure of ability to abstract is the logical form of the reason. There are two general types of reasons, super-ordinate and complexive. A super-ordinate reason is one that states a common characteristic of the items in the group, such as "they are all animals," or "they both have horns," or even, "this one has horns and that one has horns." A complexive grouping does not single out any one attribute as common to all but makes "local groups" such as "goat is like a cow because they are both milked," or "the cow is like the dog because they are both black." Unlike previous findings (with both American and African children), I found a majority of the youngest group were able to give super-ordinate reasons. The results for all children are presented in Table IX.

The conclusions in this paper all are tentative, as I am still in the process of conducting my research. However, I feel that even these early findings attest to the superiority of using material familiar to the children being tested.

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TABLE I

LEARNING ADULT DIMENSIONS

	6 & 7 yrs	9 yrs	12 yrs
Per cent children giving any adult reason	60%	70%	100%
Total number of adult reasons (all children)	10	12	25
Reasons Given			
1. Fly, has wings	40%	70*	38%
2. Hoofs vs. paws	10%	0%	20%
3. Four-legged or walks	0%	0%	50%
4. Habitat: wild, domestic, or water	30%	40%	60%
5. Edibility	0%	0%	20%
6. Eating habits: grass vs. meat	10%	0%	10%
7. Milked vs. not milked	10%	10%	10%

* Percent of children giving these reasons.

TABLE II

COW-GOAT, CHICKEN-DUCK, SORTING VS. REASONS

	6 & 7 yrs	9 yrs	12 yrs
Cow-Goat			
Per cent children grouping them together	60%	60%	90%
Per cent children grouping together with adult reasons	30%	50%	90%
Chicken-Duck			
Per cent children grouping together	60%	70%	80%
Per cent children grouping together with adult reasons	10%	50%	80%

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TABLE III

WILD-DOMESTIC-WATER-DIMENSION

Animals Placed Together	7 yrs	9 yrs	12 yrs
Dog-Cow Together	60% *	50%*	30% *
Mentioned "Domestic"	0%	20%	30%
Fish-Frog Together	60%	70%	60%
Mentioned "Water"	60%	20%	50%
Zebra-Elephant Together	50%	30%	20%
Mentioned "Wild"	20%	30%	20%
Alternate sorting by adult dimensions (hoofed vs. paws; edible vs. nonedible)	0%	0%	30%

*Per cent of children

TABLE IV

ANIMALS VS. BIRDS

Animals Placed Together	6 & 7 yrs	9 yrs	12 yrs
Duck-Owl Together	40%	50%	60%
Duck-Owl Together and gave reason: fly, has wings	0%	40%	60%
Rat-Monkey Together	10%	20%	60%
Gave Reason: Walk, has 4 legs	0%	0%	30%

TABLE V

WILD ANIMALS: SORTING

Pairs in Final Sort	9 yrs.	12 yrs.
Leopard-Tiger	70%	90%
Giraffe-Zebra	60%	50%
Elephant-Buffalo	60%	40%

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TABLE VI

WILD ANIMALS: DIMENSIONS

	9 yrs	12 yrs
Per cent children giving any adult reasons	40%	70%
Total number of adult reasons (all children)	5	13

TABLE VII

FREE SORTING TESTS

	6 & 7 yrs.	9 yrs.	12 yrs.
Fly or Has Wings	40%	70%	80%
Walks or Has Four Legs	0%	0%	50%

TABLE VIII

SEVEN YEAR OLDS: PERCEPTIBLE VS. NON-PERCEPTIBLE REASONS

	% of Children Who Gave Reasons[1]	% Within Each Group Who Gave Particular Reasons[2]
Perceptible Reasons Exclusively	38%	
Colour		67%
Other Aspects of Appearance		33%
Non-Perceptible Reasons Exclusively	63%	
Habitual "actions"		100%
"Flies"		60%
Are "wild animals"		60%
Live in grass		40%
"Stay together"		40%
Eat alike		20%
Are "domestic animals"		20%
Live in trees		20%
Lay eggs		20%
Are milked		20%

Note[1] This table reports only children who were able to give reasons.
Note[2] A child may mention more than one reason.

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TABLE IX

LOGICAL FORM OF REASONS[1]

	6&7 yrs.	9 yrs.	12 yrs.
1. Unable to give reason	20%	10%	0%
2. At least 1 super-ordinate reason	80% (100%)[1]	90% (100%)	100%
3. At least 1 complexive or relational reason	30% (38%)	0%	0%
4. All super-ordinate reasons	50% (63%)	90% (100%)	100%

[1] Figures in parentheses indicate the percentage totals of those children who were able to give reasons.

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